*PHYSICS 112 — SUMMER 2005 — Homework for June 14, 2005*

**Due in recitation during the first five minutes; after that, worth only 50% as much.**

**Name** ______________________________ **Section** __________

**In parts (1a) through (1c), consider the two dimensionless vectors $\vec{A} = (3.10, 2.40)$ and $\vec{B} = (-3.60, +1.70)$.**

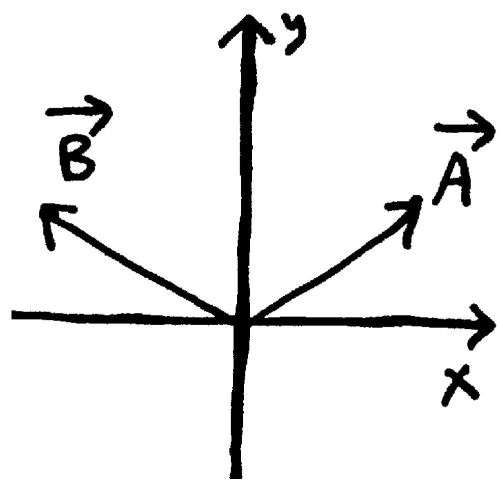
**(1a) Evaluate $A$, the magnitude of $\vec{A}$.**

$$A = |\vec{A}| = \sqrt{(3.10)^2 + (2.40)^2} = \sqrt{15.37} = 3.92$$

**(1b) Evaluate $B$, the magnitude of $\vec{B}$.**

$$B = |\vec{B}| = \sqrt{(-3.60)^2 + (1.70)^2} = \sqrt{15.85} = 3.98$$

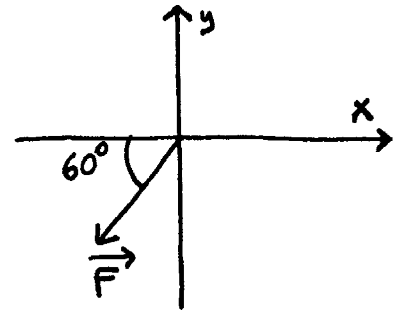
**(1c) Sketch and label these two vectors on an appropriately-labeled coordinate system below, drawing them approximately to scale. Label the four quadrants in the usual way. Name the quadrant in which each vector is found.**




$\vec{A}$ is in the first quadrant and $\vec{B}$ is in the second quadrant.

**(2a) Suppose the vector $\vec{F}$ in the $xy$ plane has a magnitude of 6.40 N (6.40 newtons) and lies in the third quadrant, making an angle of 60° with the negative $x$ axis. Make a sketch of the coordinate system and draw the vector, showing the 60° angle. Then determine the components of this vector and express the vector in the form ($x$ componet, $y$ component).**

The vector is shown in the diagram. Since it lies in the third quadrant, it must have an $x$-component $F_x$ that is negative, and a $y$-component $F_y$ that is negative. $\vec{F}$ is at an angle $\theta = 240°$ (measured counterclockwise from the positive $x$-axis).




Using trigonometry we see that

$F_x = F\ \cos(240°) = (6.40\text{ N})(-0.5000) = -3.20\text{ N}$

and $F_y = F\ \sin(240°) = (6.40\text{ N})(-0.8660) = -5.54\text{ N}$

Thus $\vec{F} = (F_x, F_y) = (-3.20\text{ N}, -5.54\text{ N})$.

**(2b) Verify that your vector expression in part (2a) has the correct magnitude.**

We expect to find $F = |\vec{F}| = \sqrt{F_x^2 + F_y^2} = 6.40$ N. Let's check it out.

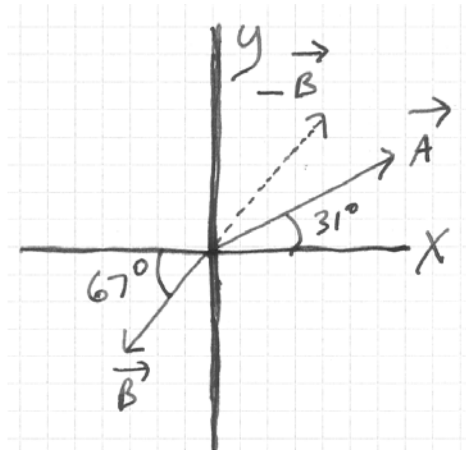
$$F = \sqrt{(3.20\text{ N})^2 + (5.54\text{ N})^2} = \sqrt{(10.24\text{ N}^2) + (30.69\text{ N}^2)} = \sqrt{40.93\text{ N}^2} = 6.40\text{ N}.$$

**(3) Consider these two vectors:**

**$\vec{A}$ has a length of 7.4 m and is directed 31° N of E**

**$\vec{B}$ has a length of 5.8 m and is directed 67° S of W**

**Determine the components, magnitude, and direction of $\vec{A} - \vec{B}$. Draw a sketch to accompany your solution.**




The easiest way to do this is to determine the components of the two vectors. From the sketch we expect $\vec{A}$ to have positive components and $\vec{B}$ to have negative components, as shown in the sketch. Calculating the components:

$\vec{A} = ((7.4 \text{ m})(\cos 31°), +(7.4 \text{ m})(\sin 31°)) \;\; = (6.3 \text{ m}, \; +3.8 \text{ m})$

$\vec{B} = ((5.8 \text{ m})(\cos 247°), (5.8 \text{ m})(\sin 247°)) \;\; = (-2.3 \text{ m}, \; -5.3 \text{ m})$

Then $\vec{A} - \vec{B} = (8.6 \text{ m}, \; 9.1 \text{ m})$

whose magnitude is $|\vec{A} - \vec{B}| = \sqrt{(8.6 \text{ m})^2 + (9.1 \text{ m})^2} = \sqrt{156.77 \text{ m}^2} = 12.5$ m which should probably be written as 13 m, to 2 significant figures.

The direction of $\vec{A} - \vec{B}$ is at an angle $\theta = \tan^{-1}(\frac{9.1 \text{ m}}{8.6 \text{ m}}) = \tan^{-1}(1.06) = 47°$. This is in the first quadrant, as seems correct when you check the sketch for the vectors $\vec{A}$ and $-\vec{B}$.